Meeting Schedule & Thesis Updates
MSc Ocean Physics, University of Victoria

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Contents

1 Meetings

1.1 September 13th, 2019

- **Work**:
  - Meeting with Steve Mihaly 1:30pm Friday @ ONC
  - Read Alford et al (2012) and review references (Pinkel, Mihaly)
  - Obtain a sample data set and create a time series for last year (average between hours)
  - Plot u, v, w
  - Install Python modules: NetCDF4, xarray, dask
  - conda install
  - import xarray as xr with xr.open_dataset('data.nc') as ds print(ds)
  - ds.time for variables, etc.
  - tab completion with Jupyter
  - ONC data: Backscatter? Echo intensity? Error in velocity?
- **To do**:
  - Initial plots (scales) for all three sites, monthly data (July and January)
  - Note any issues for ONC

1.2 October 15th, 2019

- **Work**:
  - No Axis July data, 2019
  - Plots for Mideast 150 kHz, July / January 2018; Upper Slope 75 kHz, July / January 2018; Axis 75 kHz, January 2018
  - Questions:
  - Explain 'line magic'
  - xarray for data visualisation
  - reverse depth for plots
  - vmin and vmax optimal values
- **To do**:
  - Basic filtering: single depth, remove average
  - Wind correlation: Johannes (DFO La Perouse data)
  - Ed for DNS access from home
  - Beam doppler values to Steve for troubleshooting
  - Low-pass 30h filter to remove tides
  - Read Thomson/Mihaly for west coast currents, copy methods
  - Total data – filtered data = residual data
  - Notebook for results, publish to GitHub

Reading Notes – Oct. 4$^{\mathbf{th}}$:

Alford *et al* (2012) - Annual Cycle and Depth Penetration of Wind-Generated Near Inertial Internal Waves at Ocean Station Papa in the Northeast Pacific

Near-inertial internal waves are one of two processes that dominate the internal wave band, along with internal tides, and are typically the result of passing storms. They are likely responsible for much of the mixing in the deep ocean, through a cascading effect of kinetic energy flux that reaches into, and then well beyond the mixed layer. Most of this energy is imparted in discrete energetic events (storms, through dissipation, and vertical and lateral propagation), prominently in the winter, that partition into vertical modes upon descent. Findings show a significant portion of wave groups propagating downwards beyond 800m. Analysis shows internal wave motions dominating the two-year energy spectra (83%), with near-inertial frequencies accounting for 47% (and energies accounting for up to 33% of wind work observable in surface layers). These quantities, relative to stratification estimates, suggest near-inertial internal waves are

likely an important source of energy in the deep ocean.

Questions :

- Barotropic (constant density along isopycnal) versus baroclinic (varied density along isopycnal) versus internal tides?
- Different modes simply different frequencies imparted by the passing storm?
- KHz rating for ADCPs?
- What is the importance of mixed layer depth (MLD)?
- Velocities strongly clockwise polarised due to Coriolis?
- Able to research most unfamiliar terms and concepts, but most confusion arises from the description of data processing techniques (such as fourth-order Butterworth filter). I expect this knowledge will largely arise with experience.

1.3 November 8th, 2019

- **Work**:
  - Optimise low-pass filter for tides, do not average for velocity profiles.
  - GitHub repository > kurtisanstey/project
  - Send beam doppler values to Steve Mihaly
- **To do**:
  - Wind data > 46139 La Perouse / Amphitheatre lighthouse / Tofino airport
  - SSH for DNS connection (Ed)
  - Hayley waves textbook
- **Questions**:
  - Real FFT units for y-axis
  - Real or combined Real and Imaginary FFT
  - PSD peaks correspond to tidal frequencies
  - Begin NSERC application

1.4 November 15th, 2019

- **Work**:
  - Optimise filter (40-hour Butterworth)
  - Log-log plots for PDS
  - Jupyter widgets integrated
  - Improve PDS
  - Interpolate for NaN values, set depth range to avoid noise at range extent
  - Add markdown to Notebooks for comments
  - Filtered and residual data comparison, write a for loop to do this for each depth
- **To do**:
  - Wind data (Ed network / Tofino airport)
  - SSH for DNS connection (Ed)
  - Hayley waves textbook
  - Local tidal frequencies
  - Revise NSERC application

1.5 November 23rd, 2019

- **Work**:
  - Improve visual clarity of plots (comparison, scales, labels, etc.)
  - Use np.interp vs pandas
  - Add Jody's .bib file to Mendeley
  - Revise NSERC application
- **To do**:

  - Add scholarly contributions to GitHub
  - Fix Afficio entry on CV
  - Further internal waves reading
  - Lab work on Wednesday, 1:30pm

1.6 December 2nd, 2019

Wave tank with 2-layer (salinity based density difference) flow, generating internal waves over a submerged object, visible through the use of photodegradable dye.

1.7 December 16th, 2019

- **Work**:
  - Axis & Upper Slope v3 (opt. tide loop/general code)
  - Optimised filter and plots
- **To do**:
  - General reading: Surface waves, 2-layer waves, waves textbooks, continental slope papers
  - Suggested reading: Gemmrich, Klymak 2011, Turner, Thomson (Cali), Munk 1981, Kunze/Gregg 1991, Klymak/Pinkel 2008
  - Create summaries of papers and useful techniques
  - GM Toolbox
  - 2-month 15-minute data sets
  - Plot shear and combined velocity (u+v) spectra
  - Buoyancy frequency
  - Sync GitHub
  - Critical latitude/resonance
  - Tidal constituents
  - Critical slope angles
  - LaTeX/bibdesk

1.8 January 6th, 2020

- **Work**:
  - Directed reading
  - Readings club
  - Sync GitHub
  - Tidal constituents
  - Improved filter
  - Noise averaging, smaller y-range, frequencies, comparative spectra, dates
- **To do:**
  - GM Toolbox > Buoyancy frequency
  - Shear spectra (du/dz)
  - Rotary Spectra > spectrogram
  - Critical latitude / resonance
  - Wind data (Ed/Tofino)
  - Haley waves textbook
  - Rotate velocity profiles $\tilde{u} = u + iv \rightarrow u_{\text{new}} = \tilde{u}e^{i\theta}$
  - Process to loop through data/plot (glob and xarray.open_mfdatasheet)
  - Improve code
  - LaTeX/BibDesk

1.9 January 28th, 2020

- **Work**:
  - Check available data (see notes)

  - Parzen window for wider binning, nperseg to 400 for averaging (smaller window size for high frequency)
  - Tidal constituents
  - Improved plots
- **To do**:
  - Buoyancy frequency (GC La Perouse)
  - GM Toolbox
  - Shear (du/dz), rotary, spectrogram, crit. lat., resonance, slope angle
  - Process/script/improve code (see Jan. 6)
  - Rotate spectra
  - Wind (Ed/Tofino)
  - Error bars, units, reorganise comparisons, comments

1.10 February 25th, 2020

- **Work**:
  - Interpretations of spectra (see notes)
- **To do**:
  - Winter vs summer plots + axis + annual + plot over each other
  - Summer climatology, year matters
  - GM spectra > WKB scaling
  - More comments
  - Smaller window size for high freq. > better averaging
  - 15-min 2-month data sets
  - Process to generate plots / improve code (see earlier notes)
  - Shear, rotary, crit lat and resonance, slope angle, wind, spectrogram
  - LaTeX / BibDesk
  - Haley waves textbook
- **Meeting notes:**
  - Plot total velocity $u^2 + v^2$
  - Plot -2 slope line until GM
  - Plot N^2 for summer + winter; WKB scaling for N
  - Plot average 2018 vs winter & summer; Plot average of earliest year vs 2018
  - Rotate for slope angle (u,v > complex > e^{itheta} > Re, Im > new u,v)
  - Depth mean spectra vs baroclinic
  - Compare with papers, offer more interpretation
  - **SEND PLOTS EARLIER**

1.11 March 1st, 2020

- **To do**:
  - Winter vs summer / annual (*same Notebook*) / spectra overlaid
  - Upper slope vs axis (15 min / 2 month)
  - Climatology for summer / annually, then plot $N^2$for winter and summer (WKB?)
  - GM (see earlier notes)
  - Comments, interpretation, and captions in a new LaTeX document
  - Better averaging for high frequency PSD (see earlier notes)
  - Shear/rotary/crit lat and resonance/slope angles+scat+refl/wind(Ed/Tofino/ONC)/Spectro
  - BibDesk / Haley waves textbook / Readings
- **Priority from meeting**:
  - -2 slope line for PSD until GM
  - Adjust for slope angle (see earlier notes)
  - Compare with nearby papers w/ similar conditions

  - Plot average 2018 vs winter/summer 2018 and earliest year possible
  - Depth mean spectra vs individual depths
  - **Send plots earlier!** LaTeX document to keep up
  - Check for backwards depths
  - Compile code
  - Deviation spectrum u –u
  - Fit continuum slope Ae^k vs Be^k

1.12 March 16th, 2020

- **Priorities**:
  - LaTeX doc + **send plots earlier**
  - Better averaging (see earlier notes)
  - Rotate spectra (see earlier notes)
  - Compare w/ other papers
  - Plot N^2 for summer/winter through depth: climatology for summer + annually > WKB scaling > plot GM spectra instead of -2 line
  - Plot avg. annual behind summer/winter, and vs other years (earliest/all)
  - Plot deviation spectrum $u - \overline{u}$
  - Plot fits for continuum slope Ae^k vs Be^k
- **To do:**
  - Compile/optimise code > auto-generate all plots from 15-min 2-month data sets
  - Shear (du/dz) / rotary (see earlier notes) / crit. lat. + resonance / slope angle + scat. + refl. / wind (Ed/ONC) / Spectrogram
  - Switch to BibDesk (after getting LaTeX going)
  - Haley's waves textbook
  - Continue reading
- **Meeting notes**:
  - Meetings changed to Tuesday, and digital due to COVID-19 constraints.
  - Classes cancelled until further notice, though assignments/projects are still due.
  - Resolve LaTeX issues, and send to Jody.
  - Check when grades are due, to potentially delay PHYS 580 project.

1.13 March 24th, 2020

- **Completed**:
  - Fix LaTeX issues and send document to Jody.
  - Convert from Mendeley to Bibdesk to use with LaTeX.
  - Preliminary rotation of velocities (test 30°angle). Rotation direction confirmed (requires $e^{-i\theta}$)
  - Better averaging for visual clarity of spectral peaks.
  - Check when grades are due, to potentially delay PHYS 580 project. Jennie says one week after the end of the exam period (see email, forwarded info to Jody).
- **Priorities**:
  - Finish adding plots and captions to LaTeX document
  - Determine proper angle to rotate spectra
  - Compare w/ other papers in region (Mihaly ∼300km away and >1000m deeper, only somewhat useful for comparison, aka should be very different)
  - Plot avg. annual behind summer/winter, and vs other years (earliest/all)
  - Plot deviation spectrum $u - \overline{u}$
  - Plot fits for continuum slope Ae^k vs Be^k
  - Plot N^2 for summer/winter through depth: climatology for summer + annually > WKB scaling > plot GM spectra instead of -2 line
- **To do:**

  - Compile/optimise code > auto-generate all plots from 15-min 2-month data sets
  - Shear (du/dz) / rotary (see earlier notes) / crit. lat. + resonance / slope angle + scat. + refl. / wind (Ed/ONC) / Spectrogram
  - Haley's waves textbook
  - Continue reading
- **Meeting notes**:
  - Finish LaTeX doc (add missing winter plots/Axis)
  - Rename u and v to cross-slope and along-slope velocities, respectively
  - Look for Mihaly's A1 site for comparison data
  - Prioritise annual spectra (seasonal vs, yearly vs, decadal)
  - Committee? Jody Klymak; Steve Mihaly; Richard Dewey; Rick Thomson; Johannes Gemmrich

1.14 April 2nd, 2020

- **Completed**:
  - Check when grades are due, to potentially delay PHYS 580 project. Recent email says May 15.
  - Did Jody receive Assignment #11 for PHYS 580?
  - Plotted rotated velocities and spectra, with captions, for Upper Slope summer 2018.
  - Better averaging for visual clarity of spectral peaks (can leave this alone for now).
  - Optimised code for producing rotated plots (still not automated).
  - Rename u and v to cross-slope and along-slope velocities, respectively, for all rotated instances.
  - Finished adding descriptive captions to all plots already present in document.
- **To do (priority)**:
  - Finish adding Upper Slope winter and Axis plots with captions to LaTeX document.
  - Plot avg. annual vs seasonal, annual, and decadal
  - Compare w/ other papers in region, look for Mihaly A1 site research
  - Plot deviation spectrum $u - \overline{u}$
  - Plot fits for continum slope Ae^k vs Be^k
  - Plot N^2 for summer/winter through depth: climatology for summer + annually > WKB scaling > plot GM spectra instead of -2 line
- **To do:**
  - Compile/optimise code > auto-generate all plots from 15-min 2-month data sets
  - Shear (du/dz) / rotary (see earlier notes) / crit. lat. + resonance / slope angle + scat. + refl. / wind (Ed/ONC) / Spectrogram
  - Committee? Jody Klymak; Steve Mihaly; Richard Dewey; Rick Thomson; Johannes Gemmrich
  - Haley's waves textbook
  - Continue reading
- **Meeting notes**:
  - Continue with priority list.
  - Can take chair from school for back.
  - Don't need to make code too fancy, just easy to use.
  - Can average time series in smaller chunks (2-month) and then combine for annual averages, etc.

1.15 April 7th, 2020

- **Completed**:
  - Improved plots to be more comparative and reduce sheer number of individual figures.
  - Finished adding rotated Upper Slope winter 2018 plots (with captions) to LaTeX document.
  - Added interpretation section to end of document to provide a running summary of captioned descriptions.
  - Added 2018 annual plot, but it's incorrect (see priority list, below).
  - Fixed code to call specific depth and time ranges for any input dataset, to work with 15-minute interval data (filters and FFT) versus previous hourly, and to merge datasets when necessary.

Much better!

- **To do (priority)**:
  - Focus on finishing the term.
  - Committee members and meeting? Jody Klymak; Steve Mihaly; Richard Dewey; Rick Thomson; Johannes Gemmrich
  - Replot Upper Slope w/ 15-minute resolution data for 2018.
  - Plot avg. annual vs seasonal, annual, and decadal (2-month and combine for annual averages).
  - Plot Axis ADCP data versus Upper Slope
  - Compare w/ other papers in region (look for Mihaly A1 site research). Need to begin telling story.
  - Plot deviation spectrum $u - \overline{u}$
  - Plot fits for continum slope Ae^k vs $\mathrm{B}e^k$
  - Plot N^2 for summer/winter through depth: climatology for summer + annually > WKB scaling > plot GM spectra instead of -2 line
- **To do:**
  - Shear (du/dz) / rotary (see earlier notes) / crit. lat. + resonance / slope angle + scat. + refl. / wind (Ed/ONC) / Spectrogram
  - Analyse residual data
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
  - Continue reading
- **Meeting notes**:
  - Email Rick Thomson, cc. Jody and Steve. Description of work, maybe show a spectra (winter vs summer?) and description.
  - Instead of worrying about velocities, get a matrix of spectra that can be saved to netCDF. e.g. for each two-month slice compute the spectra and save the amplitude for each frequency bin, compile. That way all spectra have same resolution/binning/etc.

1.16 June 16th, 2020

- **Completed**:
  - Updated thesis schedule to better reflect committee meeting discussion and presentation slides.
  - Improved commenting on in-progress spectra matrix code, and reorganised/improved formatting of code.
  - Improved velocity plots to be more comparative, and corrected date range issues for velocity data (but now there is a strange line, need to check all the winter 2018 plots for date range issues; there is the same issue with w, for sure).
  - Contacted Steve regarding the cruise he mentioned during the committee meeting.
  - Began adjusting committee meeting outline to become the official Project Proposal. Ask Jody about what to keep and what to add.
  - Merged all the data for Upper Slope 75 kHz ADCP. Working on Axis.
  - Replotted Upper Slope w/ 15-minute resolution data for 2018, to check code working as it should. Winter has date range issues.
  - Quick re-read of some earlier papers to try and understand them better (Mihaly and Thomson; Garrett and Munk, etc.). Need to read again to summarise methods and come up with questions.
- **To do (priority)**:
  - Ask Jody about the Fluids grade that still doesn't show up on the UVic site.
  - Finish matrix code, and better document code (technical appendix).
  - Read, and document potential methods (below) and questions for Jody.
  - Work on Project Proposal.
- **To do:**
  - Fix date range issues with Slope winter 2018 plots.
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).

  - Haley's waves textbook
  - Continue reading and evaluate papers for potential research methods. Ask Jody questions. Code and document code. Work on Project Proposal.
- **Meeting notes**:
  - Meetings to be held Tuesdays at 11am.
  - Split time between coding, documenting code, reading and evaluating papers, and working on project outline.
  - Matrix is only a tool for analysis. If not working well, use simpler methods.
  - For next time, have some reading notes, proposal outline, and analysis prepared.
  - Matrix should be for every depth (3D matrix).
  - Ask Jennie about grades.

1.17 June 23rd, 2020

- **Completed**:
  - Confirmed Fluid grade with Jennie.
  - Heard from Steve regarding the Akash cruise he mentioned, waiting to hear back with more information.
  - Adjusted meeting outline to serve as an outline for the project proposal.
  - Comparative velocity data for Upper Slope in 2012 to Thomson plots to visually check coherence, to reference for current information moving forward.
  - Reading of three papers (see below), summarising results and useful methods (updated). Questions to be asked.
- **To do (priority)**:
  - Finish matrix code, aside (3D, through depth), and better document code (technical appendix).
  - Read, and document potential methods (below) and questions for Jody.
  - Work on Project Proposal.
- **To do:**
  - Add fM_2 and M_4 lines to spectra. See reading notes.
  - Fix date range issues with Slope winter 2018.
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
- **Meeting notes**:
  - Look for two-week pulses in velocity data / spectrograms.
  - Check Rick's book for general oceanographic concepts.
  - Check Alford articles for information on rotary spectra.
  - Create a spectrogram for along-slope velocity data, using a log scale for frequency, a specific depth, and a time scale that are all relevant. Scale frequencies and velocities to try and show something.

1.18 July 14th, 2020

- **Completed**:
  - Created a spectrogram for along-slope velocity data, for 2018 to compare with previous seasonal data. Still trying to find a paper with a spectrogram to compare with. Difficult to interpret; may need adjustments as suggested by Jody.
  - Updated schedule with an annual PSD for 2018, including fM_2 and M_4 frequencies, as from Mihaly and Thomson. This could indicate non-linear wave-wave interaction as a means of energy decay for internal waves, due to downward wind internal waves and upward topographic internal tides. There should be winter intensification. Look into their relative energy (versus total). Rotary spectra useful for analysis. Can compare to this paper, though they look at a greater depth (2000 m) and distant site (250 km).
  - Reading (see below), summarising results, useful methods (updated), and questions to be asked.

  - Updated plots and analysis in this document as relevant to readings.
- **To do (priority)**:
  - Improve spectrograms.
  - Read, and document potential methods (below) and questions for Jody.
  - Work on Project Proposal.
  - Document code for a technical appendix.
- **To do:**
  - Fix date range issues with Slope winter 2018.
  - Finish matrix code as an aside (3D, through depth).
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
- **Meeting notes**:
  - Add depth to spectrogram.
  - Captions updated to be more descriptive (depth, mean-removed, etc.).
  - Show all data, can zoom in later.
  - Save Sxx and other matrices for later use, rather than calculating each time.
  - log10 the Sxx for better visual clarity, and multiply by frequency-squared to 'whiten'.
  - Show examples of work if stuck.
  - 2D spectra (time/depth) as To Do (Priority) analysis.
  - For internal waves, both cross- and along-slope are important.
  - N**2 climatology through depth, for summer and winter, annually ¿ WKB scaling ¿ GM spectrum as To Do (Priority) analysis.
  - Rotary spectra for To Do (Priority) analysis.
  - Seasonal wind forcing as To Do (Priority) analysis.
  - Research 'σ-t surface'

1.19 July 21st, 2020

- **Completed**:
  - Updated a spectrogram for along-slope velocity data, for 2018 to compare with previous seasonal data as a sample. Added specific depth to plot, removed y-axis limits, updated caption, set color normalisation to log10, and 'whitened' (multiplied Sxx by frequency**2). Still trying to find a paper with a spectrogram to compare with. Next, create one for each year to look for trends.
  - Obtained and formatted climatology data from Line P cruises (DFO) for winter and summer of 2009 - present.
  - Wrote code to calculate density (UNESCO 1983) and buoyancy frequency (N^2) through depth, for winter and summer, annually. What is the best depth range to use for finding dρ/dz? Should all plots have the same frequency scale, regardless of the shallow spike? Plots sent in email. Next steps are WKB scaling and then using a GM toolbox for the spectrum.
  - Began rotary spectral analysis. Not complete, as the FFT of the vector form of the horizontal velocity is giving me NaN values.
  - Reading (see below), summarising results, useful methods (updated), and questions to be asked.
  - Updated plots and analysis in this document as relevant to readings.
- **To do (priority)**:
  - Spectrograms annually, for both cross- and along-shore velocities.
  - WKB scaling for buoyancy and velocity (Alford) > plot GM spectra instead of -2 line (Alford).
  - Rotary spectra (Alford/Mihaly).
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and canyon upwelling (Allen).
  - 2D spectra (time/depth).
  - Read, and document potential methods (below) and questions for Jody.

  - Work on Project Proposal.
  - Document code for a technical appendix.
- **To do:**
  - Finish matrix code for spectra as an aside (3D, through depth).
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
- **Meeting notes**:
  - N seems high (6e-3 Hz). Use 'Seawater' toolbox for EoS calculations, compare to my results.
  - Split N2 plots into shallow and deep. Share axes. No WKB stretch necessary, as N doesn't change much below 100m.
  - Plot density profiles
  - Do not label conductivity (C) as salinity (S), or vice versa.
  - No need of for loops if a variable is vectorised.
  - Move legend off of spectrogram plots, remove smoothing, save as PDF. Annual plots, zoom in on notable events, determine timescale of events similar to storms (compare with wind data).
  - Rotary spectra can use a scipi PSD routine (probably not Welch).

1.20 July 28th, 2020

- **Completed**:
  - This week some extra TA duties were necessary to complete, as the course is now over.
  - Writing of some award statements for UVic graduate awards.
  - Moved legend to the side of spectrogram plots. Removed smoothing. Changed save format to rasterised PDF. Began creation of rough annual plots, but these need to be checked vs data gaps to ensure proper coverage. Figure this out then plot the annual spectrograms for Axis ADCP.
  - There is an issue with depth. As time progresses the depth data becomes changes in resolution, and this is causing issues with my code to automatically create the spectrogram each year. Working on creating each annual plot manually, while I figure it out.
  - Shifted analysis to end of document, for better organisation.
  - No reading this week.
- **To do (priority)**:
  - Update plots in thesis schedule document.
  - Annual plots, zoom in on notable events, determine timescale of events similar to storms (compare with wind data). Both cross- and along-shore data.
  - N seems high (6e-3 Hz). Use 'Seawater' toolbox for EoS calculations, compare to my results. Split N2 plots into shallow and deep. Share axes. No WKB stretch necessary, as N doesn't change much below 100m. Plot density profiles. Do not label conductivity (C) as salinity (S), or vice versa.
  - Use N^2 data to plot GM spectra instead of -2 line (Alford).
  - Rotary spectra (Alford/Mihaly). Use a scipy PSD routine (not Welch).
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and canyon upwelling (Allen). Also to compare to intervals of internal wave activity visible in spectrograms.
  - 2D spectra (time/depth).
  - Repeat for Axis data.
  - Read, and document potential methods (below) and questions for Jody.
  - Work on Project Proposal.
  - Document code for a technical appendix.
- **To do:**
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
- **Meeting notes**:

- Continue with last week's methods.
- For the depth issue, either a) homogenise the datasets, b) remap to a single depth scale, or c) pick a specific depth and interpolate onto it, when necessary. (c) is probably the best option.
- Update Jody next Thursday or Friday, as he is away until the 12th.
- Schedule a meeting for after the 12th, closer to the date.

1.21 August 25th, 2020

- **Completed**:
  - Further optimised code for automating plots of N^2, spectrogram, PSD, and velocity, for both ADCP.
  - Linearly interpolated for missing depth values, as depth resolution improved over the total duration of the dataset. Checked vs ONC data output and data gaps are in the appropriate places; nothing (or very little) seems to be missing. Will add the 55 kHz Axis ADCP to fill some data gaps.
  - Remade spectrogram plots for all years, and both Upper Slope and Axis ADCP, using the interpolated depth data. Moved legend to the side. Removed smoothing. Updated save format to rasterised PDF, and also automated the titles and filename for each plot that is generated. Plots available in the spectro_plots folder on GitHub.
  - Remade velocity plots for all years, both Upper Slope and Axis ADCP. Plots available in the vel_plots folder on GitHub.
  - Used Seawater package for more accurate calculations. Split N^2 plots into shallow (¿-200 m) and deep (¿-200 m). Plotted density, temperature, and salinity profiles alongside. Shared axes for comparison between seasons, years, and the shallow/deep split. No WKB stretch necessary, as N doesn't change much at all below 100 m. Changed label of salinity from (C) to (S). Plots available in the N2_plots folder on GitHub.
  - Finished adapting a Python package for the GM81 spectrum. Added the GM spectrum to annual spectra, but not yet to the monthly/seasonal spectra.
  - Nearly have rotary spectra working. Using Rick's book as a guide for the FFT process.
  - Compiling of required documents for graduate awards.
  - Shifted reading notes to end of document, for better organisation. See this new section for details of weekly readings, if interested, and I'll bring up relevant questions when necessary.
  - General update to brief interpretation section, reflecting improved insight over time.
  - Two papers reviewed, among others read; see 'Relevant reading' section at the end of this document.
- Updated brief analysis section, below.
- **To do (priority)**:
  - Update schedule document with plots.
  - Zoom in on notable events, determine timescale of events similar to storms (compare with wind data). Comparison of Axis and Upper Slope plots.
  - Get data from additional Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years.
  - Redo monthly/seasonal spectra with GM line, and annual to fix vline colours.
  - Redo spectrograms with borderless legend.
  - Finish rotary spectra (Alford/Mihaly). Use a scipy PSD routine (not Welch).
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and canyon upwelling (Allen). Also to compare to intervals of internal wave activity visible in spectrograms.
  - 2D spectra (time/depth).
  - Read, and document potential methods (below) and questions for Jody.
  - Work on Project Proposal.
  - Document code for a technical appendix.

- **To do:**
  - Inquire with Steve regarding the unreliable Mid-East ADCP data (could be useful if fixed).
  - Haley's waves textbook
- **Meeting notes**:
  - GM spectrum should go to infinite at f. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation).
  - For rotary spectra, try making a fake circular dataset to practice on, to see if things are working properly.
  - Show 'odd spikes' in spectra in the velocity data (zoom in to the period in question for that frequency).
  - Where the PSD 'flattens out' there could be the 'noise floor' of the ADCP. Get the specs and plot that line.
  - Plot comparative data between years and ADCP.
  - Spectrograms at upper and lower depths for both ADCP. Profile vs depth of high frequency energy vs depth to show strength of these peaks/seasonality at different depths.
  - Spectrogram units are off (it's whitened). Be careful of units, always.
  - New analysis document. Summarise with plots, point form or paragraph for each point of analysis.
  - Thesis proposal (why, importance, what's been done/lit review, is it an advance?), etc.

1.22 September 17th, 2020

- **Completed**:
  - Primarily writing and developing plots for a Preliminary Analysis document to record potential findings. Also moved and updated any relevant information from this document to there.
  - Created an outline for the first few sections of my Thesis document, including a start on writing the introduction and methods sections. Needs plenty of work.
  - 6 more papers reviewed (most within the past 10-15 years), among others skimmed; see 'Relevant reading' section at the end of this document for details.
  - Courses (Thursday evenings) and TA work (Friday afternoons) began again, last week. These should only require about two days a week, total.
  - Coding on pause recently to catch up on reading and writing. Primarily need to finish rotary spectra, among other things. Using Rick's book as a guide for the FFT process, and Jody's suggestion of a sample dataset.
  - Revised code for optimised output of desired figures (mainly how figure titles are automated to suit any customisation I want from a plot).
- **To do**:
  - New analysis document. Summarise with plots, point form or paragraph for each point of analysis.
  - Thesis proposal (why, importance, what's been done/lit review, is it an advance?), etc.
  - Finish rotary spectra (Alford/Mihaly). Use a scipy PSD routine (not Welch). For rotary spectra, try making a fake circular dataset to practice on, to see if things are working properly.
  - GM spectrum should go to infinite at f. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Add to all spectra.
  - Spectrogram units are off (it's whitened). Need to fix. Be careful of units, always.
  - Zoom in on notable events, determine timescale of events similar to storms (compare with wind data). Comparison of Axis and Upper Slope plots.
  - Show 'odd spikes' in spectra in the velocity data (zoom in to the period in question for that frequency).
  - Get data from additional Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East ADCP data, as it could be useful for a three-way comparison.

  - Where the PSD 'flattens out' there could be the 'noise floor' of the ADCP. Get the specs and plot that line.
  - Plot comparative data between years, seasons, annual seasons, and ADCP. Spectrograms at upper and lower depths for both ADCP. Profile vs depth of high frequency energy vs depth to show strength of these peaks/seasonality at different depths.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and canyon upwelling (Allen). Also to compare to intervals of internal wave activity visible in spectrograms.
  - 2D spectra (time/depth).
  - Read, and document potential methods (below) and questions for Jody.
  - Document code for a technical appendix.
- **Meeting notes**:
  - Add importance and personal opinion to reading notes.
  - Create a draft proposal/outline, with the finished product to be ready by mid-October, and a draft in three weeks. Can send Jody drafts whenever, for feedback.
  - For next week, finish/continue the Analysis document, send proposal outline with goals and relevant papers (a day early), and share a notebook with a test case of rotary spectra.

1.23 September 24th, 2020

- **Completed**:
  - Continued to expand the Proposal document introduction and methods sections. Added project goals (research questions). Updated relevant reading/references.
  - For the Analysis document, completed plots and analysis for two sections, Axis 75 kHz ADCP, and N^2 and CTD data. Added outlines for Axis 55 kHz ADCP and 'Upper Slope vs Axis' sections, to come next.
  - Used Rick's book and his source Gonella (1972), as well as some in-progress code from GitHub, as a guide to develop an example rotary spectra case. I'm still doubtful it's working correctly, but I think I have it lined up with the math, as described. Sent via Jupyter Notebook file to Jody.
  - Adjusted spectrogram and N^2 units.
  - Revised N^2 and CTD plots for comparative scales.
  - Two papers reviewed, relevant to rotary spectra; see 'Relevant notes' section at the end of this document for details.
  - Added 'Importance' and 'Personal opinion' to reading reviews.
  - Courses (Thursdays) and TA work (Fridays), as usual. As expected, 2-3 days of work each week.
- **To do**:
  - Finish thesis Proposal document (why, importance, what's been done/lit review, is it an advance?) by mid-October. Be specific for 2-3 project goals. Expand with more of a roadmap. Others are optional, but possible.
  - Finish rotary spectra (Thomson, Gonella). Perhaps send test case to Rick to see what he thinks?
  - Get data from additional Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East ADCP data, as it could be useful for a three-way comparison.
  - Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable, between instruments.
  - GM spectrum is wrong, it should go to infinite at f. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all spectra.
  - Identify ADCP noise floor to indicate on PSD.
  - Plot the profile through depth of high frequency energy vs depth to show strength of these peaks/seasonality at different depths.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-

inertial internal waves that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - 2D rotary spectra (time/depth), see Pinkel.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Proposal. Be specific for 2-3 project goals. Expand with more of a roadmap. Others are optional, but possible.
  - Rotary. Add some noise. Frequency output is 'positive definite', so CCW for a CW spectrum still shows up (maybe it's actually negative). Use more data points, more ω, longer period. Throw out half of the spectrum since only half of the frequencies are real, then double the amplitude. Maybe add a tide going in mostly one direction. See Pinkel for 2D rotary spectra examples.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.
  - Continue with Analysis additions.

1.24 October 5th, 2020

- **Completed**:
  - For the Proposal document, expanded each of the proposed primary research goals to be descriptive of the process to be followed, more of a roadmap. Expanded the relevance of each method of analysis to the proposed research goals. Expanded methodology for each form of analysis, and added 2D and rotary spectra descriptions. Ideally, a mostly complete rough draft could be delivered for critique by the end of the week, or next meeting.
  - Finished rotary spectra test case. Added more data points, higher ω, and a longer period to better interpret the results of the test case code. Added some noise, and M2 tide in mostly the u direction. Threw out half of the spectrum since only half of it is real, and doubled the amplitude. Spectra appear to be as expected.
  - For the Analysis document, rotary spectra plots are being made. The 55 kHz data is still being plotted, once rotary plots for the other two ADCP are finished.
  - Obtained updated data from ONC for the 55 kHz ADCP (see above), along with data for the Mid-West and Mid-East ADCP for potential comparison in cases where Upper Slope and Axis are not overlapping. Formatted data for analysis (convert to NetCDF, combining data sets, and some interpolation to deal with data gaps and NaN values in time and depth).
  - One chapter reviewed; see 'Reading notes' section at the end of this document for details.
  - Courses (Thursdays) and TA work (Fridays), as usual. As expected, 2-3 days of work each week. Course is proving to be very difficult, and the assignments are time consuming.
- **To do**:
  - Finish thesis Proposal document Introduction (why, importance, what's been done/lit review, is it an advance?) with examples of analysis, by mid-October.
  - Update Analysis document with rotary spectra plots. See Pinkel for 2D rotary spectra examples, time/depth.
  - Convert and plot Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East and Mid-West ADCP data, as it could be useful for a three-way comparison. Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable between instruments.
  - GM spectrum is wrong, it should go to infinite at f. Careful of one-sided amplitudes. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all spectra.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.

  - Cross-section of local bathymetry.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - 1D rotary spectra to start. Then 2D, as finding an optimal window will be difficult.
  - Approach other students, and past students, for support in PHYS 502.
  - Proposal edits, rotary spectra, and finish some items on checklist for next week.

1.25 October 8th, 2020

- **Completed**:
  - Continue editing Proposal.
- **To do**:
  - Finish thesis Proposal document Introduction (why, importance, what's been done/lit review, is it an advance?) with examples of analysis, by mid-October.
  - Update Analysis document with rotary spectra plots. See Pinkel for 2D rotary spectra examples, time/depth.
  - Convert and plot Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East and Mid-West ADCP data, as it could be useful for a three-way comparison. Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable between instruments.
  - GM spectrum is wrong, it should go to infinite at f. Careful of one-sided amplitudes. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all spectra.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.
  - Cross-section of local bathymetry.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Continue as previous meeting.

1.26 October 15th, 2020

- **Completed**:
  - Continue with Proposal edits. Finished thesis Proposal document Introduction (why, importance, what's been done/lit review, is it an advance?) with examples of analysis.
- **To do**:
  - Finish final edits of Proposal.
  - Update Analysis document with rotary spectra plots. 1D, then see Pinkel for 2D rotary spectra examples, time/depth.
  - GM spectrum is wrong, it should go to infinite at f. Careful of one-sided amplitudes. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all

spectra.
  - Convert and plot Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East and Mid-West ADCP data, as it could be useful for a three-way comparison. Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable between instruments.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.
  - Cross-section of local bathymetry.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Focus on importance, remove fluff, essay style with argument, and what's new.
  - Continuum is very important, for confirming seasonal changes related to wave-wave interaction, breaking, etc. Read Alford's student's paper again for more details. Needs to be more of a focus.
  - Send final draft of Proposal to Jody by early next week.

1.27 October 22nd, 2020

- **Completed**:
  - Final edits of Proposal document.
  - Continue to check out rotary averaging.
- **To do**:
  - Update Analysis document with rotary spectra plots. 1D, then see Pinkel for 2D rotary spectra examples, time/depth.
  - GM spectrum is wrong, it should go to infinite at f. Careful of one-sided amplitudes. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all spectra.
  - Convert and plot Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East and Mid-West ADCP data, as it could be useful for a three-way comparison. Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable between instruments.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.
  - Cross-section of local bathymetry.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Final edits by early next week. Get to work on To Do list to catch up.

1.28 October 29th, 2020

- **Completed**:
  - Final draft of Proposal document sent to Jody. After review will send to Steve and Rick for feedback.

  - Finally figured out averaging for rotary spectra using CSD/PSD functions in SciPy, and it works! Normalisation also checks out. See rotary_test.ipynb for details. Test case for Upper Slope 2013 looks good as compared to papers such as Mihaly 1997. See the Rotary section in analysis.ipynb for details.
  - Working on fixing issues with locally calibrated GM spectrum.
  - Reading focused on rotary spectra interpretation and continuum analysis. See 'Reading notes' section for details.
- **To do**:
  - Update Analysis document with rotary spectra plots. 1D, then see Pinkel for 2D rotary spectra examples, time/depth.
  - GM spectrum is wrong, it should go to infinite at f. Careful of one-sided amplitudes. f should be in radians in input code. Careful of K and P energy vs total energy when getting GM spectrum. N^2 shouldn't be Hz^2, it should probably be $[rad/s]^2$ (see GM documentation). Adjust in all spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum is very important for confirming seasonal changes related to wave-wave interaction, breaking, etc. Read Alford's student's paper again for more details. Needs to be more of a focus.
  - For deep flow in and upper flow out of the canyon, check velocity rotation.
  - Cross-section of local bathymetry.
  - Seasonal wind forcing (Ed/ONC/NOAA/NARR or buoy 46206 (Allen)) for downward near-inertial internal waves and inertial currents (rotary) that may affect deep ocean mixing (Alford/Allen), and equatorward current that force canyon upwelling (Allen). Also for simple comparison to intervals of high frequency activity visible in spectrograms.
  - Convert and plot Axis 55kHz ADCP to fill some data gaps and resolve issues with Axis 75 kHz in later years. Inquire with Steve regarding unreliable Mid-East and Mid-West ADCP data, as it could be useful for a three-way comparison. Update Analysis document with Axis 55 kHz and cross-instrument comparison sections. Fix PSD axes so that they're the same and comparable between instruments.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Begin using GitHub project manager for To Do list. Link docs on GitHub.
  - Finish Proposal when Jody gives final edits.
  - Finish with rotary spectra for other years. PSD still important for baseline comparisons. Why is M2 greater in CW than CCW? Find consistency relations. Spectrograms for rotary spectra. Check Gill, and Klymak 2015. Is there a GM rotary spectrum?

1.29 November 5th, 2020

- **Completed**:
  - GitHub now primary tool for tracking project. Added a readme, and linked all docs.
  - Final draft of Proposal document sent to Jody. After review will send to Steve and Rick for feedback.
  - GM spectrum up and running between f and N, but has too much energy by comparison.
  - Reading focused on GM and buoyancy relationship. See 'Reading notes' section for details.
  - Midterm + TA, as usual.
- **To do**:
  - Update docs and GitHub, regularly.
  - GM spectrum is wrong, has too much energy. Check vs other papers to see if process works OK.
  - Rotary spectra (1D and 2D).
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.

  - Deep flow in and upper flow out of the canyon.
  - Local bathymetry.
  - Characterise seasonality.
  - Check Axis 55 kHz data.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Check GM vs other papers. If wrong, let the package creator know. Check vs Jody package.

1.30 November 19th, 2020

- **Completed**:
  - Proposal approved and sent to Rick and Steve for review.
  - GM spectrum more appropriate, but not sure why (just redid it the same as before). Should compare to papers again and show Jody proof that it's working correctly.
  - Created coarse local bathymetry map. Jody will provide high-res data.
  - Rotation for velocities double-checked, looks good.
  - Reading focused on GM process. See 'Reading notes' section for details.
  - Class + TA, as usual.
- **To do**:
  - Update docs and GitHub, regularly.
  - GM spectrum is working, but need to prove it.
  - Rotary spectra (1D and 2D).
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Create high-res local bathymetry map.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Plot potential density, not density. Different scales for upper and lower depths. Use specific depth for GM process.
  - Why is my new GM process correct? Prove vs papers, show parameters. Find mistake.
  - Keep up with flow in flow out event for Axis.
  - Get better GEBCO data from Jody.
  - Kunze and Gregg for rotary GM.

1.31 November 26th, 2020

- **Completed**:
  - Confirmed GM spectrum by comparing with Alford 2012, but can't find my mistake (checkpoints don't work).
  - Checking Cairns & Williams for rotary GM process.
  - Replotted buoyancy and CTD data with appropriate scales and potential density.
  - Reading focused on fixing GM process. See 'Reading notes' section for details.
  - Class + TA, as usual.
- **To do**:
  - Update docs and GitHub, regularly.
  - GM spectrum is working, but need to prove it.
  - Rotary spectra (1D and 2D).
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.

  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Create high-res local bathymetry map.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Improve bathymetry using Jody's high-res data.
  - Add Notebook extension to Jupyter.
  - Mention jklymak in GitHub for updates.
  - Plot θ and not T.
  - No sidereal days.
  - For GM, use the KE spectrum only. Alford GM not explicit enough with parameters (WKB stretch? Divide by 4?).
  - Check Jody's posted articles for rotary GM spectra details, and check references.
  - Do some more reading on canyon inflow and outflow, and spring-neap effects (to indicate mixing as a driver).

1.32 December 4th, 2020

- **Completed**:
  - Better confirmation of GM spectrum accuracy.
  - Replotted bathymetry with higher resolution data.
  - Replotted potential temperature instead of temperature.
  - Reading focused on canyon flows. See 'Reading notes' section for details.
  - Class + TA, as usual.
- **To do**:
  - Update docs and GitHub, regularly.
  - GM spectrum is working, but need to prove it.
  - Rotary spectra (1D and 2D), and rotary GM spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Add Rick and Steve's suggestions to doc and GItHub. Read over break, and develop a list of questions for them. Show Jody, first.
  - Check Axis data for issues (see velocity plots for bad spots). Gaps? Instrument swaps?
  - Keep interpolation to a few hours, maximum.
  - SciPy to read matlab files for 55 kHz data, then convert to NetCDF using xarray.
  - 1/2 GM for rotary and component PSDs.
  - Consider WKB scaling when comparing GM spectra. Typically 5.2e-3 unless otherwise stated.

1.33 December 11th, 2020

- **Completed**:
  - Readjusted GM process, and compared with both Chen 2019 and Alford 2012 and it matches!
  - Levine and Polzin use different rotary GM processes. Compared, and consult with Jody.
  - Reading focused on GM parameters and comparing my spectrum with published work. See

'Reading notes' section for details.
  - Requested Axis 55 kHz ADCP velocity data from ONC.
  - Optimising analysis code to better deal with data gaps.
  - Final exam Monday, and extra grading this week.
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D), and rotary GM spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Request ONC Axis 55 kHz data, cc Steve.
  - Recheck rotary GM with other papers. Try squared, and maybe a factor of $1/(2\text{omg}^2)$ for proper units? Try (omg^2 + f^2).
  - Depth mean spectrum is a squared quantity, so it can be lower than the others.
  - Try GM process with vector arrays.

1.34 December 17th, 2020

- **Completed**:
  - Unsuccessful in finding additional papers to compare rotary GM spectra with. Literature seems to agree that the factors should be squared.
  - Requested Axis 55 kHz ADCP velocity data from ONC. Worked with them to figure out permissions issues to get NetCDF data.
  - Trying to optimise analysis code to better deal with data gaps, which occur due to instrument swaps/adjustments that slightly change depth values (horizontal banding).
  - Reading focused on GM parameters and comparing my spectrum with published work. As well, new tidal analysis by Alford. See 'Reading notes' section for details.
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D), and rotary GM spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - If close in depth, load datasets separately. Or debug current process; try loading each dataset and interpolating onto the original so the depths are the same.
  - Get averages of annual inflow/outflow, and plot an arrow on the map. Adjust velocity levels for more visual clarity when discussing the inflow/outflow.
  - May want to show extent of ADCP beam in the velocity plots.
  - Update bathymetry to use 50m or 100m bins, and contours.
  - Start using rotary spectra for analysis with rotary GM.
  - Check original IWEX papers for rotary GM information.

1.35 December 23rd, 2020

- **Completed**:
  - Reworked bathymetry for better depth binning and contours.
  - Trying to optimise analysis code to better deal with data gaps, which occur due to instrument swaps/adjustments that slightly change depth values (horizontal banding).
  - Reading focused on better understanding the suggestions of Steve and Rick, and the IWEX spectrum. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D), and rotary GM spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality.
  - Check Axis 55 kHz data to fill data gaps.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Continue as previous.

1.36 January 7th, 2021

- **Completed**:
  - Addition of rotary GM to rotary spectra, for comparison. Updated all PSD and rotary plots, and adding to Analysis document.
  - Data depth mapping optimisation in-progress.
  - Reading focused on better understanding the suggestions of Steve and Rick. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D), and rotary GM spectra.
  - Filter barotropic tides from spectra to check for residual baroclinic (internal) tides.
  - Continuum evaluation.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality.
  - Document code for a technical appendix.
  - Read more!
- **Meeting notes**:
  - Continue as previous.

1.37 January 14th, 2021

- **Completed**:
  - Email to Rick and Steve to organise mid-February meeting.
  - Data depth mapping optimisation completed!
  - Significant update to Analysis document.
  - Reading focused on managing large datasets. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for de-

tails.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Set specific working hours.
  - Baroclinic K1 signal could indicate shelf waves.
  - Whitening could indicate solibores.
  - Add description of depth-banding fix and other custom processes.
  - Upload intermediate plots more often.
  - Determine noise floor from single ping accuracy.
  - Deal with temporal data gaps by splitting time series, processing, then adding together (with appropriate averaging, weighting, etc.) for desired length.
  - Email ONC about the Axis 75 kHz data.
  - Bug Jody to check the Analysis document.

1.38 January 21st, 2021

- **Completed**:
  - Working with ONC to resolve data quality issue with Axis 75 kHz ADCP.
  - Scheduling for meeting still up in the air.
  - Set working hours are working... sort of.
  - Developed noise floor process from instrument calibration settings.
  - Working on a process to split datasets and recombine once their PSD have been calculated, automatically.
  - Reading focused on noise floor statistics for FFT and PSD, and managing dataset gaps. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Try 6 pings for noise floor
  - Check spectra integrate to variance.
  - Use overlap and proper window for Welch PSD.
  - Check a few days of raw data for each instrument.
  - Meeting Friday Feb 26.
  - Interpolate small gaps only.
  - Do PSD manually, save each window.
  - Check new Axis 75 data.
  - Summarise previous MSc at Barkley Canyon.

1.39 January 28th, 2021

- **Completed**:
  - Noise floor progress.

  - Updated PSD process.
  - Reading focused on noise floor statistics for FFT and PSD, and managing dataset gaps. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Update docs and GitHub, regularly.
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Use some averaging for checking noise floors.
  - Focus on high frequency.
  - Write out noise floor calculations.
  - Double check data quality with ONC.

1.40 February 4th, 2021

- **Completed**:
  - Writing of depth quality algorithm.
  - ONC back and forth for data quality check. Waiting on their metadata team.
  - Noise floors working properly.
  - Designing a presentation for the meeting.
  - Need reference for job applications.
  - Reading focused on the MSc thesis for Barkley Canyon, for comparison. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Potential group chats on Monday afternoons.
  - From previous MSc make comparisons, check phase propagation. But rather focus on broadband and inertial wind forcing.
  - Get ONC to send a 'data plan' showing the changes they've made.
  - For meeting, highlight progress since last meeting, data quality investigations, and the previous MSc findings.

1.41 February 11th, 2021

- **Completed**:
  - Finally figured out a process to deal with data gaps! Applying to all analysis processes.
  - ONC sent new data with appropriate beams and metadata. Ze will do a thorough comparison, later.
  - Committee meeting presentation in the works.

  - Reading focused on data gap management. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Deep flow in and upper flow out of the canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Finish with the data gaps process.
  - Check new Axis 75 kHz data.
  - Fix Axis 55 kHz noise floor.
  - Redo all plots with new process and depths.
  - Meeting presentation with progress, previous MSc, and thesis outline

1.42 February 18th, 2021

- **Completed**:
  - Applied data gap process to all analysis types, with samples to check consistency.
  - Checked new Axis 75 kHz data.
  - Figured out the Axis 55 kHz noise floor (with Jody's help).
  - Cannot determine upper canyon depth flow (unreliable data at that distance for Axis), but mid/lower canyon flow trends towards inflow, throughout the year.
  - Committee meeting presentation in the works.
  - Reading focused on previous thesis and canyon flow, to supplement presentation. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Mid/deep flow into canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Low freq. spectrogram plots, summation plots, save matrices.
  - 15 pings per ensemble (on average), check with ONC re ping averaging intervals, cell size parameter vs depth cell size metadata. Need actual data for intensity, correlation, etc. Compare raw 2014. Send Jody previous comparison plots, website ExcludeBeam info, timeline dates w/ notes, in a Python notebook so printable.
  - Recreate velocity plots to show relevant info when making a case (in this case showing a year makes residual velocities seem long period). Could show tidal amplitude (squared or smoothed) or 40-hour filtered spring neap cycle. Show flow averages (month/annual) and directions for flow claims.

1.43 February 25th, 2021

- **Completed**:
  - Axis 55 kHz discussion with ONC. Using 15 pings (on average) for now. They will follow up.

  - Axis 75 kHz report sent to Jody. He will follow up about correlation and intensity data, and getting records of their changes, with effects on data and why they were implemented.
  - CMOS abstract submitted.
  - Reading focused on previous thesis and canyon flow, to supplement presentation. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Mid/deep flow into canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Send Jody copy of CMOS abstract.
  - Change meeting presentation to reflect science findings, more so than thesis outline or updates.

1.44 March 5th, 2021

- **Completed**:
  - Rough outline of K1 'story' shaping up. Six doctor's appointments this week...
  - CMOS abstract sent to Jody, and expense form to Kalisa.
  - Reading focused on regional mean currents and CTW from Juan de Fuca strait. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Mid/deep flow into canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!
- **Meeting notes**:
  - Continue as before.

1.45 March 11th, 2021

- **Completed**:
  - Rough outline of K1 'story' shaping up. Waiting for updated plots re stratification dependence.
  - CMOS fee forms submitted, just waiting for disbursement.
  - Reading focused on regional mean currents and CTW from Juan de Fuca strait, and internal waves in canyons. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Rotary spectra (1D and 2D). See GitHub issue for details.
  - Mid/deep flow into canyon.
  - Characterise seasonality (annual, inter-annual, seasonal, spring-neap). See GitHub issue for details.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Read more!

- **Meeting notes**:
  - Kelvin waves move ALONG the shelf, could be part of the depth dependence at Upper Slope.
  - Plots of depth/band integrals vs time on x-axis. Bin them every two weeks or a month.
  - Consider different coordinate systems for Axis and Upper Slope.

1.46 March 18th, 2021

- **Completed**:
  - Rough outline of K1 'story' shaping up, mostly for Upper Slope.
  - WKB stretching applied to spectra.
  - Reading focused on the structure of CTW. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Time-depth-power plots.
  - Different coordinate systems between sites.
  - Direction vs depth.
  - Stats for analysis types.
  - Rotary versions of everything (1D and 2D). See GitHub issue for details.
  - Seasonal wind patterns.
  - Use non-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:
  - Look at CTW/shelf wave structure (Brink, Allen, Dale...).
  - Statistically significant analysis? Get error bars for depth-power spectra (use velocity variance at each depth bin? Maybe a histogram of variance at each depth.).
  - Rework code to save matrices at each major step, then load from there. Separate into individual notebooks, or distinct sections that don't rely on running all of the previous sections. Use XArray for NetCDF storage. Send Jody 'pseudo-code'.

1.47 March 25th, 2021

- **Completed**:
  - Significant rework of code to be an iterative process making use of xarray to save and load .nc files. Much more efficient.
  - Minimal reading, mostly related to Python code. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Time-depth-frequency matrices.
  - Time-depth-power plots.
  - Different coordinate systems between sites.
  - Direction vs depth (principle axis?).
  - Stats for all analysis types.
  - Rotary versions of everything (1D and 2D). See GitHub issue for details.
  - Seasonal wind patterns (notable for near-inertial band).
  - Use non-vertical-mean-removed data to look at barotropic contributions.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:

  - Set attributes in xarray for single variables.
  - Show code to Jody.
  - Look up mode 1 zero crossing for internal waves on a slope.
  - Dale and Sherwin for pictures of depth vs power for tides.

1.48 April 1st, 2021

- **Completed**:
  - ONC data check. Quality data added to RDI instruments, still waiting for additions to Nortek devices.
  - Depth-frequency-time matrices for PSD spectra.
  - K1 analysis progress.
  - Reading related to CTW for diurnal analysis. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Stats for all analysis types.
  - Seasonal wind patterns (notable for near-inertial band).
  - Use non-vertical-mean-removed data to look at barotropic tides and spring-neap.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:
  - Shift certain code to post-processing.
  - Fact-check observations from reading, then write.
  - Check vertical scales.
  - Get rotary versions of depth-frequency-time matrices.

1.49 April 9th, 2021

- **Completed**:
  - MANY coding updates, including rotation for each site, rotary depth-freq-time matrices, and rotary versions of spectrograms and depth-band plots. Code is looking to be in great shape.
  - Rotary-based plots support trends from PSD-based plots.
  - Reading related to CTW for diurnal analysis. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Stats for all analysis types.
  - Seasonal wind patterns (notable for near-inertial band).
  - Use non-vertical-mean-removed data to look at barotropic tides and spring-neap.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:
  - Check chi2 error estimation for how to get error bars for spectrograms or depth-band plots.
  - Plot the depth-mean as a time series to check barotropic and spring/neap contributions (can filter to show diurnal tide, even).Or use a tidal model to show correlation.
  - Investiage vertical scales.

1.50 April 15th, 2021

- **Completed**:
  - Additional grading contract.

  - Wind data from Neah Bay buoy. Smoothing.
  - Began f analysis and plotting.
  - Diurnal analysis writing and referencing.
  - Reading for diurnal analysis. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Stats for all analysis types.
  - Use non-vertical-mean-removed data to look at barotropic tides and spring-neap.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:
  - Smooth the wind vectors, not the direction and magnitude.
  - Check Alford for slab model f wind analysis filter, dependent on change in rotation and magnitude.
  - Get wind spectrum to determine f contribution strength.
  - Check mid-depth and min/max depths to see if there's more going on with the notable weather related inertial signals.

1.51 April 22nd, 2021

- **Completed**:
  - CMOS acceptance and volunteering.
  - Update time axes scales for annual plots.
  - Update bathymetry with rotation axes.
  - Smooth wind direction using complex vector.
  - Depth-mean band-pass time series to show barotropic contributions (spring-neap).
  - Begin near-inertial band write-up.
  - Submit diurnal band write-up to Jody for review.
  - Reading for both diurnal and inertial analyses. See 'Reading notes' section for details (when applicable).
- **To do**:
  - Stats for all analysis types.
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in the Analysis document!
  - Write-up for K1, f, M2, and continuum.
  - Read more!
- **Meeting notes**:
  - Apply to be CMOS volunteer.
  - Adjust plots to publish.
  - Get barotropic power from depth-band integrated data. Compare with surface tides (timing) from global source, or ONC pressure gauge.
  - Send Jody outline by Monday. Describe, compare, explain. Also note a few papers with good structure.

1.52 May 6th, 2021

- **Completed**:
  - CMOS volunteering.
  - Monday meeting presentation.
  - Diurnal outline.
  - Outline for each other band (subdiurnal, inertial, semidiurnal, continuum).
  - Multi-annual averaging for seasonality.
  - Barotropic comparison with Tofino surface levels.

  - Reorganisation of thesis into chapters based on major effects: seasonality, near-shelf effects, canyon effects, and continuum analysis.
  - Reading notes moved to separate document, as now reading is most often in support of writing.
- **To do**:
  - Stats for all analysis types.
  - Blue-shifts (and lack thereof)
  - Document code for a technical appendix. Also make sure that anything done process-wise is described in thesis!
- **Meeting notes**:
  - Surface levels need to be compared with same process as for depth-band integrated power plots. Take spectra, filter frequency band, integrate.
  - For continuum select narrower band ($>$ M_4 and $<$ N). For this band check power, but also amplitude fit versus -2 spectrum, and GM comparison.

1.53 May 20th, 2021

- **Completed**:
  - Adjusted thesis sections to highlight effects, rather than specific frequency bands.
  - Fleshed out much of the supplementary thesis sections, and reorganised the Slope Effects section with better descriptions and additional comparisons.
  - Critical slope analysis of Upper Slope, which is supercritical to subdiurnal, diurnal, inertial, and semidiurnal constituents, suggesting reflection.
  - Initial continuum fitting.
  - Proper barotropic comparison.
  - CW wind spectra.
- **To do**:
  - Alford (2001) inertial slab model using CW wind spectra.
  - Check mid and min/max depths for effect scales.
  - Multi-annual averaged plots for seasonality.
  - Narrower continuum band (>M4 and <N), and polyfit fits for -2 slope.
  - Note non-WKB upper boundary layer effects.
  - Band-filtered velocities for seasonality.
  - Stats for all analysis types.
  - Improve plots.
  - Incident semidiurnal wave reflection graphic.
- **Meeting notes**:
  - Link thesis in readme.
  - Prep for CMOS.
  - Introduce results generally (multi-annual ¿ seasonal ¿ small-scale).
  - Much of Methods to move to Data and Results.

1.54 June 3rd, 2021

- **Completed**:
  - Multiple meetings between now and previous regarding CMOS presentation, which is complete and went well.
  - CMOS volunteering.
  - Thesis linked in readme.
  - Depth-frequency analysis complete.
  - Alford (2001), D'Asaro (1985), and Garratt (1977) inertial slab model coded and run for 2013, using Neah Bay wind data.
- **To do**:
  - Seasonal mixed layer depth for slab model.

  - Barotropic comparisons for each direction and rotation component. Don't remove mean.
  - Check mid and min/max depths for effect scales.
  - Multi-annual averaged plots for seasonality.
  - Narrower continuum band (>M4 and <N), and polyfit fits for -2 slope.
  - Note non-WKB upper boundary layer effects.
  - Band-filtered velocities for seasonality.
  - Stats for all analysis types.
  - Improve plots.
  - Incident semidiurnal wave reflection graphic.
  -
- **Meeting notes**:
  - Thicker mixed-layer strums low modes more.
  - Get seasonal mixed-layer depths for use with slab model.
  - Is f super-inertial? Implies propagation from remote source.
  - Jody unavailable after 15th of August for a few weeks. Try to finish beforehand, or in September if that's not possible.

1.55 June 10th, 2021

- **Completed**:
  - Slab model improvements (seasonal mixed-layer depth, CW inertial energy comparison w/ inertial band seasonality).
  - f is not super-inertial.
  - Full-depth check to confirm effect scales and surface stratification intensification.
  - Incident wave ray graphic created.
  - Improved continuum fits using power law routine to find a and b for each spectra, to compare with GM, with narrower range.
  - Barotropic comparisons for 2014, using magnitude rather than individual components.
  - Band-pass velocities to discuss vertical structure.
  - Depth-mean time-mean spectra for generalisation.
  - All plots 'improved' and re-run.
  - CMOS volunteering.
- **To do**:
  - Get wind correlations with near-inertial at both sites, for all years.
  - Ray tracing accounting for N^2.
  - Gradient at each grid point to get criticality plot. Compare with N^2, tides, near-inertial.
  - Check 2017 and 2018 for barotropic forcing.
  - Use continuum fits to get two time series; one of a and b values for each component (from $y = af^b$), and one of c values for each component (from $y = cf^{-2}$).
- **Meeting notes**:
  - Use full depth plots from now on.
  - Use band-pass velocities to inspect notable events.
  - Thick mixed-layer strums low modes; opposite for thin.
  - Higher stratification supports greater velocities, hence 'intensified' signals.
  - More writing; focus on figures and point form if necessary.

1.56 June 17th, 2021

- **Completed**:
  - Additional wind data processed for 2014, 2017, and 2018.
  - Correlation coefficients between near-inertial CW slab and ADCP power (specific depth) calculated and plotted, at both sites, for all years.
  - Additional barotropic comparisons for both sites, 2017 and 2018.

  - Thesis draft reorganised and began outlining entire copy.
- **To do**:
  - Ray tracing accounting for N^2.
  - Gradient at each grid point to get criticality plot. Compare with N^2, tides, near-inertial.
  - Use continuum fits to get two time series; one of a and b values for each component (from $y = af^b$), and one of c values for each component (from $y = cf^{-2}$).
- **Meeting notes**:
  - Wind correlations: Test vs random noise. Don't subtract mean, take square root instead. 100m for Slope comparison. Review papers and code to see if mistakes were made.
  - Barotropic comparisons: Quantify time difference when 'out of phase'. Remote forcing sources? Calculate mode 1 wave speed to see how far away. Chelton has a useful map.
  - Ask Jennie about department funding, awards, etc.
  - No TA in the fall, Jody said he will top me up to cover whatever I'm not getting.
  - Focus on making good plots that tell a story, and cross-correlate between plots (plot things together to show similarities and differences).

1.57 June 24th, 2021

- **Completed**:
  - Quantified time difference when 'out of phase'. Remote forcing sources likely JdF Ridge. Calculated mode 1 wave speed to see how far away, Chelton has a useful map. Average 2.0 m/s in this region, JdF Ridge about 2.5-3.5 days away at that speed, depending on segment. Offset is about 3.3 days (average of five offsets), which is in range.
  - Added standard error of correlation, depends on N and also that each data point is independent (which they are not, in this case, for sampling inertial frequency sine wave). 100 m Slope data made little difference. Code is working fine, rechecked with papers. However, the slab model only applies to the mixed layer. Need to implement pumping model at the bottom of the slab to check internal wave generation (mode interactions).
- **To do**:
  - Barotropic comparisons: Check other years for consistent offset. Check regional papers for observations/generation details. Global generation maps could be useful.
  - Wind correlations: Apply pumping model to determine internal wave generation.
  - Ray tracing accounting for N^2.
  - Gradient at each grid point to get criticality plot. Compare with N^2, tides, near-inertial.
  - Use continuum fits to get two time series; one of a and b values for each component (from $y = af^b$), and one of c values for each component (from $y = cf^{-2}$).
  - Continuum dissipation estimates, ϵ.
- **Meeting notes**:
  - Dissipation estimates from continuum.
  - Other papers re Endeavour. Generation maps.
  - Data points must be independent for correlations (independence/degrees of freedom). They are not, for wind comparisons, as many points sample the same near-inertial sine wave. Want to down-sample to one point per wavelength.
  - Consider structuring day for efficiency. 'Mastery' book, other books useful for improving work.

1.58 June 30th, 2021

- **Completed**:
  - Thesis draft re-write in-progress (point form with relevant figures).
  - New issue write-ups in point form with relevant figures (semidiurnal as sample).
  - Possible generation sites for M2 internal tide include Haida Gwaii, Juan de Fuca Ridge, but probably Mendocino Escarpment (over 800 km away, but 2 m/s is probably too slow. Little evidence of remote forcing in VICS studies. Average offset over years calculated.

- **To do**:
  - Barotropic comparisons: Get lag correlations (phase lag). Does vertical scale of M2 intensification also depend on spring-neap? Main point: M2 internal tides are remotely forced in the spring/summer, and local otherwise.
  - Wind correlations: Apply pumping model to determine internal wave generation.
  - Ray tracing accounting for N^2.
  - Gradient at each grid point to get criticality plot. Compare with N^2, tides, near-inertial.
  - Use continuum fits to get two time series; one of a and b values for each component (from $y = af^b$), and one of c values for each component (from $y = cf^{-2}$).
  - Continuum dissipation estimates, ϵ.
- **Meeting notes**:
  - For write-ups include main points at beginning.
  - Model JGR style guide.

1.59 July 8th, 2021

- **Completed**:
  - a and b fits calculated. Variability is very high. Better with longer window spectrogram.
  - c fits calculated, need to be plotted vs GM.
  - Graduate awards list sent to Jody.
- **To do**:
  - Barotropic comparisons: Get lag correlations (phase lag). Does vertical scale of M2 intensification also depend on spring-neap? Main point: M2 internal tides are remotely forced in the spring/summer, and local otherwise.
  - Wind correlations: Apply pumping model to determine internal wave generation.
  - Ray tracing accounting for N^2.
  - Gradient at each grid point to get criticality plot. Compare with N^2, tides, near-inertial.
  - Compare a and b with spectra to see if variability is reasonable. Check spectrogram freq vs time of spectra - fit or spectra / fit.
  - Continuum dissipation estimates, ϵ.
- **Meeting notes**:
  - Do some writing every day.
  - Meet next Tuesday at 2pm.

1.60 July 22nd, 2021

- **Completed**:
  - Full depth plots.
  - 4-month lag correlations.
  - 2.2 m/s mode 1 speeds.
  - Proper ray tracing for M2.
  - Developing pumping model.
  - c/GM ratios for continuum.
  - Continue writing.
  - Proper WKB for velocities.
  - Graduate awards due tomorrow.
  - Python update.
  - Fall finances.
  - BBQ times.
- **To do**:
  - Barotropic comparisons: Plot correlations vs lag. High-pass and/or 2-month average each month to remove low freq. contamination of signal. Check this for diurnal, too. Does vertical scale of M2 intensification also depend on spring-neap? Main point: M2 internal tides are remotely forced

in the spring/summer, and local otherwise.
  - Wind correlations: Apply pumping model to determine internal wave generation.
  - Gradient at each grid point to get criticality plot vs M2.
  - Compare a and b with spectra to see if variability is reasonable. Check spectrogram freq vs time of spectra - fit or spectra / fit. For c, try no whiten, just fit. Use better time resolution spectra. Show deviation in Axis75 vs Axis55 by fitting -2 for each over tighter frequency range (6e-5 to 1e-4) or just whiten PSD to better show slope differences.
  - Continuum dissipation estimates, ϵ. Ratio from c/GM. Get other parameters from papers.
- **Meeting notes**:
  - No TA. Jody to top up in the fall. Sent him minimum funding info.
  - Can start to look at big-picture stories, compare between analysis/bands to reduce number of plots and be concise. Include questions in write-ups!

1.61 July 29th, 2021

- **Completed**:
  -
- **To do**:
  - Barotropic comparisons: Plot correlations vs lag. High-pass and/or 2-month average each month to remove low freq. contamination of signal. Check this for diurnal, too. Does vertical scale of M2 intensification also depend on spring-neap? Main point: M2 internal tides are remotely forced in the spring/summer, and local otherwise.
  - Wind correlations: Apply pumping model to determine internal wave generation.
  - Gradient at each grid point to get criticality plot vs M2.
  - Compare a and b with spectra to see if variability is reasonable. Check spectrogram freq vs time of spectra - fit or spectra / fit. For c, try no whiten, just fit. Use better time resolution spectra. Show deviation in Axis75 vs Axis55 by fitting -2 for each over tighter frequency range (6e-5 to 1e-4) or just whiten PSD to better show slope differences.
  - Continuum dissipation estimates, ϵ. Ratio from c/GM. Get other parameters from papers.
- **Meeting notes**:
  -

2 Additional analysis

A selection of additional analysis that could be useful, if there is time.

- Inter-annual correlation to justify reference year.
- Better frequency resolution spectra for paper (and x-axis up to 10^4).
- Show tidal amplitudes (square the velocities, w/ smoothing).
- Plot deviation velocity $u - \overline{u}$, shear (du/dz), and total velocity (u+v).
- Stats for all analysis types.
- Check in with ONC regarding the ADCP beam comparison they promised.
- Document code for a technical appendix. Also make sure that anything done process-wise is described in thesis!